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Published in:
International Journal of Organizational Analysis

DOI:
10.1108/IJOA-05-2018-1427

Publication date:
2018

Document Version
Publisher's PDF, also known as Version of record

Citation for published version (APA):
Sund, K. J., Barnes, S., & Mattsson, J. (2018). The IPOET matrix: measuring resource integration. *International Journal of Organizational Analysis*, *26*(5), 953-971. https://doi.org/10.1108/IJOA-05-2018-1427

International Journal of Organizational Analysis

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The IPOET matrix: measuring resource integration

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Received 14 May 2018
Accepted 21 July 2018

Abstract

Purpose – The recently developed resource orchestration theory studies the processes by which managers handle resources to create competitive advantages. According to this theory, it is the way that resources interact with each other that results in such advantages. Resource integration, i.e. the alignment, or fit between resources, is one important outcome of resource orchestration processes. This paper aims to develop a scale and outline approaches to measuring such resource integration.

Design/methodology/approach – Using a typology of five types of resources derived from value theory, the authors develop a scale for measuring the fit between resource types, i.e. the degree of resource integration. The authors illustrate the method using a case example of an IT company and demonstrate how a variety of statistical methods including hierarchical cluster analysis, structural equation modeling, social network analysis and methods from biostatistics can provide measures of resource integration.

Findings – The authors develop a scale and associated measures that can help scholars systematically measure and identify firms with a high or low level of resource integration capability. This makes it possible to investigate further these companies and reconstruct how they support dynamic capabilities, as well as commonalities across firms with high and low levels of this capability.

Originality/value – Existing studies on resource orchestration have failed to provide us with a reliable measurement instrument that can be used both in cross-sectional work, and in repeated or time-series studies, allowing us to assess the degree to which a wider range of resources in an organization are integrated. The authors develop and demonstrate such an instrument.

Keywords Cluster analysis, Structural equation modeling, Social network analysis, Resource integration, Resource orchestration

Paper type Research paper

Introduction

There is by now ample evidence in the literature to support the core argument of resource-based theories (RBTs) of firms that identifying and developing valuable, inimitable resources yields superior performance for an organization (see, e.g. the meta-analysis of Crook, Ketchen, Combs and Todd, 2008). Yet, RBT has been criticized for leaving little or no room for

International Journal of Organizational Analysis
Vol. 26 No. 5, 2018
pp. 953-971
Emerald Publishing Limited
1934-8835
DOI 10.1108/IJOA-05-2018-1427

managerial agency (Priem and Butler, 2001). The recently emerging resource orchestration theory has shifted the focus from the study of resource types and generalized criteria for competitive advantage, toward the study of resource management capabilities. In this view, merely possessing strategic resources may not guarantee any advantage. Instead, what a firm "does" with its resources and "how" it does it becomes the focus (Hansen *et al.*, 2004; Priem and Butler, 2001; Sirmon *et al.*, 2007; Sirmon *et al.*, 2011). Resources, it is argued, must be actively managed for potential strengths in individual resources to be fully realized (Sirmon, Hitt, Ireland, and Gilbert, 2011). Using the musical orchestra analogy, effective orchestration leads to the integration of individual musicians and inspires these musicians to perform at their best (Kor and Mesko, 2013). Yet, little work has attempted to empirically measure this integration of multiple resources, despite it being considered a key outcome variable of resource orchestration.

Sirmon *et al.* (2011) have argued that three broad types of processes are involved in such orchestration, namely, resource accumulation, resource bundling and resource leveraging. Resource orchestration processes can be seen as dynamic capabilities, in the sense that they allow the firm to adapt the basis on which it competes in the marketplace. For example, resource bundling may change over time. Existing studies on resource orchestration have typically followed one of two routes. The first is the (often inductive) identification and study of orchestration sub-processes (Baert *et al.*, 2016; Eloranta and Turunen, 2016; Ketchen *et al.*, 2014; Nambisan and Sawhney, 2011; Wright *et al.*, 2012). The second is the (often deductive) study of how the interplay between specific resources or capabilities leads to competitive advantage (Liu *et al.*, Wei and Hua, 2016; Powell and Dent-Micallef, 1997; Song *et al.*, 2005; Wales *et al.*, 2013). The latter studies have led to numerous examples of how the existence of complementary resources within a firm can help build competitive advantage. In other words, this strand supports the fundamental argument of resource orchestration theory that *bundles* of resources and capabilities, rather than individual resources on their own, create advantage. In these studies, it is usually implicitly assumed that resources are *de facto* integrated, as long as they co-exist in the firm. But is this always the case? To address this question, we need to be able to identify firms with high or low levels of general resource integration, which at the very least in the musical orchestra analogy has been identified as a key management capability (Kor and Mesko, 2013; Sirmon *et al.*, 2007).

In this paper, we therefore develop a scale and associated indicators that can be used to measure the degree of resource integration in an organization. We illustrate the method using a case example of an IT company and demonstrate how a variety of statistical methods including hierarchical cluster analysis, structural equation modeling, social network analysis and methods from biostatistics can provide measures of resource integration. We also argue that the scale could be used to measure the degree of integration over time. We see the relevance of this measurement instrument in the context of further empirical work that would explore the different practices of resource integration and configuration. The remainder of this paper is structured as follows. First, we briefly review the relevant literature on resource management and orchestration and state the contribution of our research. Next, we present our research method, including the measurement tool. This is followed by an application of the research tool in an organizational context. Finally, we offer a short conclusion.

Resource integration

In their widely cited critique of the traditional RBT of competitive advantage, Priem and Butler (2001) suggest that the attributes that are thought to make resources and capabilities sources of competitive advantage are not amenable to managerial manipulation, a point partly acknowledged by Barney (2001). Resource rarity and inimitability are for example resource characteristics that depend on resource market characteristics and the nature of the resource at hand. Wernerfelt (1984) in his version of the theory argued that managers make decisions about which resources to use and which markets to enter with those resources. Yet, this still fails to account for the day-to-day management of resources (Barney *et al.*, 2001; Eisenhardt and Martin, 2000).

It is today widely recognized in the RBT literature that the competitive advantage of a firm does not lie in owning resources as such, but in the specific resource configurations managers create in a company and how these are leveraged (Miller, 2017). The processes leading to such configurations have by Sirmon *et al.* (2011) been referred to collectively as resource orchestration. To explain the dynamic role of managers in such orchestration, Sirmon *et al.* (2007, 2011, p. 1392) define resource management as "the comprehensive process of structuring, bundling, and leveraging the firm's resources with the purpose of creating value for customers and competitive advantages for the firm." They define bundling as the process of integrating resources to form capabilities. For a firm, the purpose of actively managing the integration of resources is thus to effectively utilize resources to achieve a strategic objective, such as entering or competing in a market.

The concept of dynamic capabilities is intimately linked to this configuration of resources and competences. Such capabilities are defined as how companies "integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (Teece, Pisano and Shuen, 1997, p. 516). Some studies emphasize the strictly internal dynamics of companies (Madsen, 2010; Winter, 2003; Zahra *et al.*, 2006). However, in most studies, dynamic capabilities are seen in relation to a changing environment (Eisenhardt and Martin, 2000; Teece, 2007; Teece *et al.*, 1997). Thus, dynamic capability is the "ability" of the firm to "reconfigure resources and competencies" in a "changing environment."

Challenges in the measurement of resources is a recurrent theme in literature, with numerous authors having pointed out that the heterogeneous and sometimes intangible nature of firm resources make it difficult to define, weigh and compare such resources across firms (Barney *et al.*, 2011). A similar observation can be made about resource management and orchestration. Given that resource management is viewed as a process, with a number of sub-processes, examining this directly would typically involve a time-series approach, or alternatively an experimental approach, for example, in the form of scenarios (Carnes *et al.*, 2016). The use of cross-sectional survey instruments would be more useful for measuring the *outcome* of the process, rather than internal measures of the process itself. Aside from general firm performance variables, one such measurable outcome is the perceived degree of resource integration. The few existing studies we identified where such outcome measurement has been attempted have focused on the integration or complementarity of very specific resources. For example, Song *et al.* (2005) examined the degree of complementarity of marketing and technology resources by measuring the interaction effects between such resources in determining organizational performance. They found that the importance of the interaction effect depended on environmental characteristics. Woodside *et al.* (1999) examined multiple distinct marketing competencies and how these interact with strategy to produce organizational performance. Powell and Dent-Micallef (1997) examined how human, business and technology resources might interact with information technology to make IT a valuable resource that results in competitive advantage. Their conclusion was that IT alone does not create value, but must be "merged" with the requisite human and business complementary resources. Finally, Wales *et al.* (2013), with a somewhat different approach, tested for the interaction between information and communication technology capabilities, network capability and entrepreneurial orientation (EO) in creating performance in small firms. Their suggestion is that "a small firm's information and communication technology (ICT) and network capability (NC) may enable it to more efficiently and effectively orchestrate its resources, and, thereby, enhance the efficacy of its EO efforts" (Wales *et al.*, 2013, p. 94). In the case of another recent study, this time by Chadwick *et al.* (2015), the focus was on strategic human resources management, and the authors considered commitment-based human resource management systems as an example of a resource "bundle" and the use of such a system as a measure of the degree of orchestration present.

Critically, the resource orchestration perspective implies that what is important to measure is not the presence of resources themselves, but the outcomes of processes of bundling (Sirmon *et al.*, 2011). In other words, it is not sufficient to have co-existing resources in the organization if these are not integrated. What existing studies have failed to do is provide us with a reliable measurement instrument that can be used both in cross-sectional work, and in repeated or time-series studies, allowing us to assess the degree to which a wider range of resources in an organization are integrated. Studies measuring the integration of only a subsample of resources may make the wrong assumptions about which bundles matter and which do not. Such studies may in essence suffer from missing resource integration variables. For example, two competing firms may have similarly well-integrated human and IT resources, but differ in the levels of integration of these resources with physical production resources. Studying only human and IT resources would not reveal such a difference. The measurement of resource integration should therefore take into account a more exhaustive list of resource types. Furthermore, both the internal and external perspectives should ideally be covered. A high internal alignment may mask a lack of alignment with the external environment, such as channel partners or suppliers (Liu *et al.*, 2016), a point not taken into account in the traditional RBT, which "does not consider other external environmental forces or the nature of interactions among multiple actors" (Peteraf and Barney, 2003). We here propose a scale to measure more exhaustively the level of resource integration, taking into account both the internal and external perspectives, as well as a more complete typology of resources than we have seen in any existing study of resource orchestration.

The IPOET scale

To the extent that the manager is at the heart of the process of resource integration (Sirmon *et al.*, 2008), its measurement should take place not with an instrument disconnected from the cognitions of managers, but rather be based on how managers and employees perceive, evoke and act (Grant, 1996; Pablo *et al.*, 2007). In line with Ambrosini *et al.* (2009), we take the view that managerial perceptions of both internal and external environments will directly influence decisions regarding the renewal of the firm's resource base. It is therefore appropriate to measure internal and external resource integration at the perceptual level, with organizational members as informants. We here propose and test such a scale. Note, however, that we do not intend to link it with organizational outcomes, such as performance, into a research model. Instead, we elaborate and test the scale in a psychometric way.

Development of measures

Our resource typology goes beyond the initial tripartite categorization of resources as outlined by Barney (1991) into physical, human and organizational capital or the broadly similar taxonomy of Grant (1991) into tangible, intangible and personnel-based organizational resources. As we needed a comprehensive conceptualization of resources, we opted for using value theory (Hartman, 1967) because it is formal, multidimensional and covers the entire human value realm. It has been validated long ago (Lohman, 1968; Elliot, 1969) and successfully applied in business research (Lemmink and Mattsson, 1996: Barnes and Mattsson, 2011). We apply this conceptualization deductively to formulate resource types and their underlying items. An alternative would have been a more traditional inductive scale development (Hinkin, 1998), but there is no theoretical reason for us to assume that generalizable resource categories derived in this way would differ from the already tried and tested categories found in the literature.

Built on a formal axiom of value (comparing two sets of properties of a thing) Hartman (1967) defines and orders three basic value dimensions (intrinsic, extrinsic and systemic) defined by their richness. Understood in common language, these have been termed emotional, practical and logical (Lemos, 1994; Mattsson, 1990).

According to the formal definition of value, dimensions are combined pairwise so that nine basic values can be formed. The emotional dimension is defined to be far greater in richness than the practical, which in turn is greater than the logical. This is explained by the nature and number of the properties of the respective dimensions. In this way, we have an overarching and ordered abstract model of the value realm. The key point here is that we ascertain that all three dimensions are included in a framework, and that the dimensions are combined pairwise to "mimic" and replicate the definition of value. This is an important issue as we "merge" two dimensions when formulating items, which are meant to include a synthesis of both. Hence, we need to include "empirical content" from both dimensions. In this way, we have a clear structure to how we design and formulate items.

Here, we focus on the measurement of the alignment between five key and distinct resource types, which we refer to as the IPOET (infrastructure, people, organization, economy and technology) scale and provide the following definitions:

(1) *Infrastructure (I)* is a resource type that covers the location and physical site of operations in a physical sense. It deals with geography and practicality with regard to operations and the well-being of employees. Hence, this resource type is a practical one in Hartman's sense.

(2) *People (P)* refers to the employees in the company at large; thus, human capital is generalized as one type of resource, albeit being of different age, position, gender and experience. This resource type is emotional (intrinsic) as the word people refers to individuals in the firm.

(3) *Organization (O)* refers to the abstract structural positioning of people in the company, particularly as they relate to functions and power. Organization as a resource is seen as one abstract system covering the entire company. This resource type is logical because of its abstract and systemic nature.

(4) *Economy (E)* refers to the financial capital invested in the company and its present state of profitability and projected future earnings. In other words, it is a synopsis of the economic status of the company. It is a measure of economic fitness. This resource type is also logical because it is inherently abstract.

(5) *Technology (T)* is construed as all artifacts that are used in the running of the business, including machines, software, information technology and similar systems of value to production and delivery. "Technology" is seen as a gestalt: a synopsis of all kinds of technologies used in the company being either abstract or physical. This resource type is a combination of practical and logical dimensions as it includes both physical (e.g. machines) and abstract (e.g. software) components.

As this typology of resources was developed conceptually from value theory, it can be seen as a model (Figure 1) including all dimensions of business – human, physical and abstract (e.g. money and systems). The typology is limited in number and does not include other

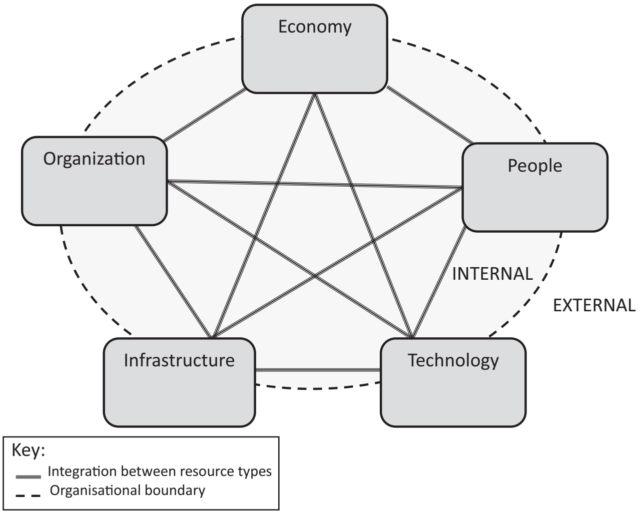

Figure 1.
Research model for resource integration

possible types such as culture, knowledge and managerial competence. Instead these "softer" components are used in formulating items. As discussed above, we have included all underlying value dimensions and also a combination of two. The typology enables practical measurement via a minimum number of resource types that present a holistic picture of the organization. Furthermore, we sought to capture two perspectives on resource integration: the *internal perspective* of how these resources are integrated within the firm and the *external perspective* of how resource integration matches the needs of the external environment.

We seek to measure the degree of fit, or integration, between these five types of resources. The more employees see a high degree of integration between resources, the higher the degree of resource integration capability we can expect from the company. As a reminder, having resources is one thing, using them effectively is another. It is the central conjecture of this paper that resource integration should ideally be captured across multiple types of resources. Our argument for this rests not only on the literature, as discussed in the previous section, but also on the following observations. Resources are always used together and not separately. For example, the people resource (P) should be aligned and fit with other resource types to be fully operational. Economy (E) should fit with infrastructure (I) so as not to overspend or misuse funding, etc. The better perceived fit, we argue, the higher the level of integration achieved by the organization, and the higher the level of resource integration capability. Below we will suggest a simple method to measure this relying on the perceptions of selected respondents close to the company.

Company staff is an important constituency to sample. If employees are asked how they perceive the *degree of fit* between two kinds of resources, such as people and technology, they will divulge a measure of the integration between these resources. As previously discussed, the perceived fit is relevant as these perceptions will be what drive organizational actions involving multiple resources, i.e. resource bundling. Hence, we suggest that a survey-based method be used to tap into how employees perceive the degree of fit between all five types of resources in their company. We are aware that conditions may vary according to place and function in the company. This variation is in itself a measure of the variability of capabilities in a large company and should be taken into account depending on the organizational context.

To measure resource integration, we first created a scale that measures the level of integration for each resource combination pair – people and infrastructure (PI), people and organization (PO), people and economy (PE), and so forth – for a total of 10 dyads (Appendix). The scale included three items for each dyad for internal resource integration and, for the sake of parsimony, one item for each dyad for external resource integration, plus an additional two overall items (one internal and one external). Thus, there were 42 items in total.

By pairwise combining the five resource types, we get an underlying structure for how to express items. All items are formulated in a positive way and respondents rate the degree of agreement (namely, the degree of fit between the resource type combinations). For example, PT1 reads: "In our company we use methods which are easy to use". "Methods" refer to Technology as a resource and "easy to use" to the People resource. PO2 reads: "Our Organization cares about People" combining the two resource types directly. The Organization-Economy item OE1 reads: "Money is allocated so as to be of best use to the organization". In a similar way, PI2 combines People and Infrastructure by the expression "Our Company's location (Infrastructure) is practical for me (People)". The external version of the combination is phrased: "Visitors (People) enjoy our offices (Infrastructure)". Hence, items were formulated by taking account of (and finding a word for) one resource type and its combination with another (for both internal and external items). Words were chosen according to their underlying value dimension. "Softer" aspects of resource use, not directly covered in the typology, were instead integrated into the items. For example, PT2 was expressed as "Our kind of teamwork improves the skills of employees". A second "soft" example PE1 reads: "Employees are keen to help the company economize". Both signal "soft" aspects of resource use. As mentioned above, the word Methods in the item PT1, incorporating both a logical and a practical dimension, was used to express Technology. "Easy to use" (practical value dimension) was used to express the link to employees (people, i.e. emotional value dimension). Finally, as mentioned, two overall items, OVI and OVX, were formulated for statistical testing reasons. Consequently, all items were formulated by taking into account of the criteria listed above. The scale was pilot tested using data collected from an IT service company in Sweden, but serving the European market (n = 34). The piloted scale was further refined using data from the main study (n = 149) at another IT company, producing surveillance products for a global market. Validity and reliability data were examined and five items that did not contribute significantly to improved reliability of dyad subscales were removed. The final measurement instrument of 35 items is shown in the Appendix. All subscales for internal resource combinations had at least two items. As we aimed only at developing an effective scale for resource integration, we did not opt for testing it in a more comprehensive way by, e.g. linking it to firm performance or other competitive measures.

Scale validity and reliability

As mentioned, we use only statistical psychometric approaches to investigate validity and reliability of scale items and do not study the scale in a comparative context by comparing different levels of resource integration and performance among firms. Table I examines convergent validity and reliability of the final internal measures. The loadings of the measures on their respective constructs ranged from 0.71 to 0.91. All constructs fulfill the recommended levels for composite reliability and average variance extracted, with all AVEs

Table I.
Validity and reliability of the internal IPOET scale

Resource combination	Factor loading	AVE	Composite reliability
IE	IE1 → 0.87 IE2 → 0.81 IE3 → 0.87	0.72	0.89
TO	TO1 → 0.90 TO2 → 0.84	0.76	0.86
PE	PE1 → 0.71 PE2 → 0.83 PE3 → 0.75	0.58	0.81
OI	OI1 → 0.95 OI2 → 0.91	0.86	0.93
PI	PI1 → 0.90 PI2 → 0.89	0.80	0.89
PO	PO1 → 0.89 PO2 → 0.87	0.77	0.87
OE	OE1 → 0.79 OE2 → 0.75 OE3 → 0.72	0.57	0.80
PT	PT1 → 0.90 PT2 → 0.88	0.79	0.88
TE	TE1 → 0.84 TE2 → 0.79	0.67	0.80
TI	TI1 → 0.87 TI2 → 0.91	0.79	0.88

having values higher than the recommended cut-off of 0.50 (Fornell and Larcker, 1981). Similarly, the values of composite reliability are above the recommended level of 0.70.

Table II examines discriminant validity. A standard test was used: the square root of average variance extracted for each construct was compared with the correlations between it and other constructs. Each construct shared greater variance with its own measurement items than with constructs having different measurement items.

Common method bias was tested using the Harman single factor test. A factor analysis on the IPOET scale revealed that the largest single factor accounted for 39.9 per cent of variance and thus common method bias did not appear to be a major concern.

To assess the predictive validity of the internal and external scales on overall integration, we ran partial least squares (PLS) path models between each complete scale and each overall

Table II.
Discriminant validity of internal IPOET scale ($\sqrt{AVE}$ on diagonal)

Resource combination	IE	TO	PE	OI	PI	PO	OE	PT	TE	TI
IE	*0.85*									
TO	0.47	*0.87*								
PE	0.53	0.59	*0.76*							
OI	0.37	0.45	0.56	*0.93*						
PI	0.50	0.62	0.62	0.49	*0.89*					
PO	0.56	0.62	0.70	0.52	0.66	*0.88*				
OE	0.52	0.40	0.66	0.50	0.56	0.64	*0.75*			
PT	0.64	0.65	0.54	0.44	0.54	0.58	0.43	*0.89*		
TE	0.59	0.58	0.47	0.44	0.55	0.54	0.50	0.61	*0.82*	
TI	0.54	0.59	0.48	0.35	0.51	0.51	0.39	0.65	0.51	*0.89*

indicator. In each case, we found that predictive validity was good. For overall internal integration, we found an explanation for 43 per cent of variance ($\beta = 0.65$; $t = 13.1$; $p < 0.001$; $R^2 = 0.43$); for external integration, a total of 28 per cent of variance was explained ($\beta = 0.53$; $t = 9.5$; $p < 0.001$; $R^2 = 0.28$).

Data analysis

In addition to some basic summary statistics, the study uses four methods of statistical analysis to identify aspects of resource integration within the firm:

(1) The overall level of dyadic resource integration priorities are examined using Ward's hierarchical cluster analysis.

(2) The alignment of resource integration between internal and external perspectives is examined using the Mantel test from biostatistics.

(3) The influence of specific resource integration dyads on overall resource integration (integration capabilities) is examined using PLS path modeling.

(4) The influence of specific resource groups on integration is examined using social network analysis.

We examine the level of dyadic resource integration using hierarchical cluster analysis. The first step is to construct a 5×5 cell matrix for the responses to dyadic resource combinations. This represents a fit matrix for the resources of the firm – the IPOET matrix. Along the diagonal, there are blanks – as we cannot rate a resource fit with itself. The minimal or least integrated matrix will have only 1s in all (non-diagonal) cells; the maximum or best integrated matrix will have 7s in cells. Based on the fit matrix data, we are able to apply Ward's (1963) minimum variance procedure of cluster analysis to model how tightly the resources are intertwined. Ward proposed a general agglomerative hierarchical clustering method within which the criterion for choosing pairs of clusters to merge at each step is based on the minimum between-cluster variance. Thus, effectively, there is no loss of variance in the method. The scores for clustering at each step are the error sum of squares (ESS), and it is these values that we use for interpreting levels of resource integration. Based on an assessment of the IPOET matrix with various values from 1 to 7 (but all with 7s on the diagonal) in Ward's (1963) algorithm, we can say that the ESS values vary from 0 (all 7s), through to 8.48 (all 1s), with 4.24 being the mid-point (all 4s).

We assessed the alignment of dynamic capabilities between the internal and external resource perspectives by using the correlation procedure of Mantel (1967). This procedure, developed in biostatistics and commonly using in ecology research, provides a very versatile method of correlating statistical matrix data in a variety of formats. We implement the approach using the Mantel Nonparametric Test Calculator 2.0 developed by Liedloff (1999), which provides the Mantel coefficient, Z, standard normal variate, g, and correlation coefficient, r, based on a randomization test (Sokal and Rohlf, 1995).

To assess the importance of specific dyadic resource combinations on overall resource integration, we conducted PLS path modeling in SmartPLS (Hair *et al.*, 2011). In particular, separate path models were tested for internal and external resource integration to examine the significant dyadic influences on overall resource integration (internal or external). Overall resource integration is taken as a proxy of capability and hence this identifies which resource combinations are most likely to afford a dynamic capability.

Social network analysis is used to assess the centralization of particular resources within the resource network (Figure 1). In particular, we use the UCINet 6.0 software package to measure the centrality of specific resources using the flow betweenness measure for valued networks (Freeman *et al.*, 1991).

Results

Sample statistics

A total of 149 valid responses were received from the case organization. A total of 79 per cent of respondents were male and 88 per cent were university educated. The mean age of respondents was 37.9 years (SD = 9.1 years) and the mean tenure was 5.0 years (SD = 5.3 years). The majority of respondents worked in the R&D department (53 per cent), with sizeable groups in Operations (17 per cent) and Information Systems (10 per cent).

Summary statistics

Table III shows the means and standard deviations of the resource combinations and the differences between internal and external measures. The means are shown graphically in Figure 2. All means are above neutral, indicating a positive view on resource combinations. Several findings are notable regarding differences between internal and external levels of integration of resources:

- There is a much lower external alignment of physical infrastructure and economy (difference = 1.33).
- There is a lower external integration of organization and economy (difference = 0.55).
- There is a lower internal alignment across P-T, T-E and O-I (differences of −0.76, −0.62 and −0.57, respectively).

Table III. Summary statistics for resource combinations

Resource combination	Mean Internal (I)	SD	Mean External (E)	SD	Difference (I – E)
PT	4.18	1.66	4.94	1.28	−0.76
PO	4.32	1.30	4.30	0.98	0.02
PI	4.25	1.06	4.34	1.27	−0.09
PE	4.62	0.99	5.04	1.32	−0.42
TO	4.23	1.16	4.08	1.45	0.15
TI	4.39	1.71	4.19	1.09	0.19
TE	4.83	1.17	5.45	1.19	−0.62
OI	4.69	1.45	5.26	1.25	−0.57
OE	5.22	1.34	4.68	1.25	0.55
IE	5.61	1.44	4.28	1.11	1.33
Overall	4.99	1.43	4.32	1.43	0.67

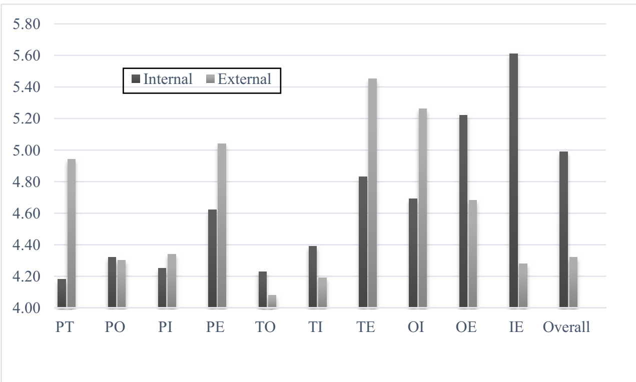

Figure 2. Levels of resource integration for dyads and overall

Overall, there is an apparent mismatch between overall perceptions of internal and external integration (M = 4.99 and M = 4.32 respectively).

Table IV transforms the resource combination data into the IPOET matrices: the internal matrix [Table IV(a)] and the external matrix [Table IV(b)]. Within these matrices, we are able to assess the overall level of specific resources perceived within the organization from the individual resource combinations. Notably, there is a moderate and reasonably balanced level of internal resources, all with means between 4.3 and 5.1, and this is strongest for level of Economy at 5.1. Similarly, there is a moderate level of external resources, but the means more tightly bunched around 4.5 (ranging from 4.5 to 4.9).

Evaluating resource integration

Figures 3 and 4 graphically illustrate the internal and external resource integration, respectively, in the firm. The firm is better integrated overall internally (a moderate ESS of 4.59 – close to the 4.24 neutral scale) than externally (a rather poor ESS of 6.23, well above the mid-point). However, within each perspective, there are some relatively tight integration bundles. Internally, infrastructure and economy are tightly integrated (ESS = 2.12), with

	I	P	O	E	T	Mean
a. Internal IPOET matrix						
I	–	4.3	4.7	5.6	4.4	*4.7*
P	4.3	–	4.3	4.6	4.2	*4.3*
O	4.7	4.3	–	5.2	4.2	*4.6*
E	5.6	4.6	5.2	–	4.8	*5.1*
T	4.4	4.2	4.2	4.8	–	*4.4*
b. External IPOET matrix						
I	–	4.3	5.3	4.3	4.2	*4.5*
P	4.3	–	4.3	5.0	4.9	*4.7*
O	5.3	4.3	–	4.7	4.1	*4.6*
E	4.3	5.0	4.7	–	5.4	*4.9*
T	4.2	4.9	4.1	5.4	–	*4.7*

Table IV. IPOET matrix: levels of organizational resources perceived (internal/external)

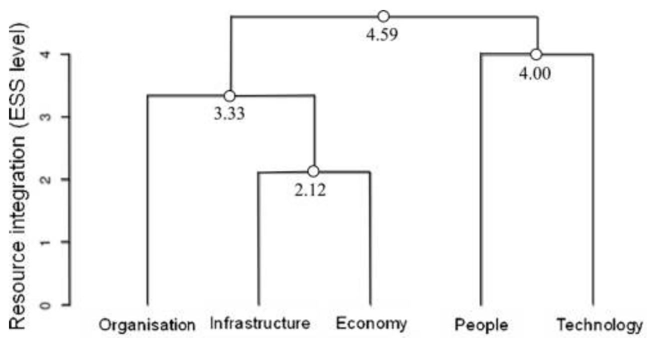

Figure 3. Overall assessment of internal integration of resource groups

organization joining this bundle at a moderate level (ESS = 3.33) and people and technology also moderately integrated (ESS = 4.00). Externally, infrastructure and organization and economy and technology are tightly integrated (ESS = 2.28 and ESS = 2.50, respectively), with people joining the last bundle at a moderate level (ESS = 3.10).

To assess which resource combinations were most influential on overall integration, we analyzed the valued network graph of Figure 1 using UCINET 6.0 (Hanneman and Riddle, 2005), based on the levels of resource integration given in Table IV, the IPOET matrix. The density of the internal resource integration network was 4.63 (SD = 0.44), while for the external network, the density was similar at 4.65 (SD = 0.45). Table V shows the centrality of the resources using the flow betweenness (FB) measure for valued networks (Freeman *et al.*, 1991). Internal-facing resources are dominated by the centralization of Economy (FB = 3.497), well above the mean level of 2.946. All other resources are below the mean FB of 2.946. Overall, the resource network is notably centralized, with a network centralization index of 5.74 per cent (Hanneman and Riddle, 2005). In contrast, the external-facing resource network is not centralized, with a network centralization index of only 0.79 per cent; all measures of FB for resources are very close to the mean level of 3.022.

As a result of the PLS path modeling, three items were significant for internal integration (R^2 = 0.49) and two for external integration (R^2 = 0.32). Alignment of Infrastructure and Economy (I-E) is seen as core to overall integration, both internal (β = 0.27; t = 2.82; p < 0.01) and external (β = 0.23; t = 2.10; p < 0.05). Alignment of both people and technology (P-T) (β = 0.27; t = 2.54; p < 0.01) and people and organization (P-O) (β = 0.24; t = 2.27; p < 0.05) are key to internal integration, while integration of technology and infrastructure (T-I) are important externally (β = 0.16; t = 2.10; p < 0.05).

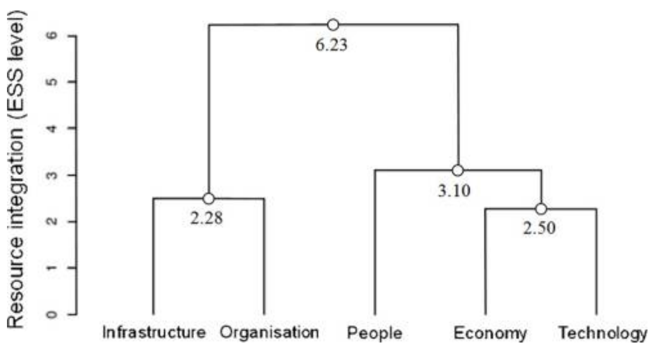

Figure 4.
Overall assessment of external integration of resource groups

Table V.
Centrality of integrated resources

Resource	Internal	External
Infrastructure	2.908	3.000
People	2.722	2.967
Organization	2.879	3.098
Economy	3.497	3.078
Technology	2.722	2.967
MEAN	2.946	3.022
SD	0.286	0.056
Network Centralization Index	5.741%	0.79%

To assess the alignment of resource integration between internal and external perspectives, we ran the Mantel (1967) test on the IPOET matrices in Tables 4(a) and (b). The resulting correlation coefficient was $r = 0.135$. The value of p was 0.697, indicating no correlation between the matrices. This suggests a divergence between the internal and external resource integration perspectives, as alluded to in the descriptive data. The Mantel Z statistic from the non-randomized data was 676.2. Comparing this result to the shuffled matrix provides a standard normal variate, $g = -2.26$. This negative result is significant at $p < 0.05$ and suggests a disconnection between the internal and external resource perspectives.

Interpretation of case results

Sirmon *et al.* (2007) identify resource management processes as critical in creating dynamic capabilities and generating value for firms in dynamic environments with environmental uncertainty. The processes identified are structuring, bundling and leveraging, in a broadly sequential manner, with feedback. Our proposed methodology has focused on measuring the perceived level of resource integration as an outcome of these processes.

The application of our approach to a sample case study has demonstrated how to use the approach in practice. The scales had internal convergent, discriminant and predictive validity. The company studied has a reasonably good level of internal and external resources at around the level of 5.0, with a notable level of economy resources, indicating strong financial acumen in the business. However, the descriptive statistics appear to suggest that there is a misalignment in perceptions of integration, with very different levels of resource integration internally and externally and between individual and overall measures. Generally, internal resource integration was stronger than external integration, with a tight integration of I-E and moderate P-O integrating with T and moderate integration between these two final clusters. These findings were explained by the fact that the company has recently moved into brand new and exclusive offices in a central urban area in southern Sweden. The offices are considered state-of-the-art and have been acquired at a very low economic cost (I-E). Interestingly, each department has its own section of particular buildings and controls the facilities which make the organization visible (P-O).

External integration has a closely aligned O-I and T-E integrating with P but weak integration between these two final clusters. This resonates with the very high level of profitability that the company has generated over the years as a world-leading supplier of IT hardware (T-E). This is driven by effective personal sales (P). Hence, this hegemony of being a success makes it perhaps now less important to achieve integration with organization and infrastructure (O-I), although this would suggest that the organization and its infrastructure could be better used to support the efficient and tech-savvy personnel in external markets. However, the main finding here is the significant overall difference ($p < 0.05$) between the internal and external resource perspectives. In the long run, from a competitive perspective, this lack of integration is likely to weaken the company's position and should be further examined.

Our PLS results identifying key areas of integration are supported by other research examining dynamic capabilities in the IT sector. The combination of information technology (T) and financially astute management capability (E) in general contributes to capabilities aimed at planning, investment decision-making, coordination and control (T-E) (Kim, Shin, Kim, and Lee, 2011). This enables firms to efficiently manage resources to transform them into business value (Peppard, 2007). Furthermore, a flexible approach to information technology infrastructure (T-I) that is able to change with business conditions and strategy is an important capability in the IT sector (Weill *et al.*, 2002) and has been found to be a statistically significant influence on dynamic capabilities and ultimately perceived firm financial performance (Kim *et al.*, 2011). Moreover, the technological knowledge and expertise of staff is necessary for the appropriate use and management of IT resources (P-T), including deployment and operation of existing systems, understanding the overarching internal business and external environment and developing new technological solutions in response to changing business requirements. Again, this is a statistically significant driver of dynamic capabilities and ultimately perceived firm financial performance (Kim *et al.*, 2011). More broadly, unit-level human capital resources can provide a dynamic capability, suggesting a convergence of literatures in strategy and strategic human resource management (Nyberg *et al.*, 2014). In our study, the people (P) resource, particularly with respect to integration with technology (T) and organization (O) resources, was important in internal resource integration, suggesting a dynamic capability.

A short conclusion

Individual de-coupled resources are not what result in a competitive advantage – it is the way that resources interact with each other that is important. Resource integration, i.e. the bundling, and specifically the alignment, or fit between resources, is one important dimension of such interactions. Managing resource integration is thus an important dynamic capability. In this paper, we have developed a measurement tool that can be used to measure to what degree the resources of a firm are integrated, and thus act as a measurement of the outcome of associated resource management capabilities. We have shown how hierarchical cluster analysis can provide measures of resource integration. A next step would be to study how different degrees of resource integration, or at a more fine-grained level, the integration between different resource pairs, impacts performance. An interesting study context in this regard is firms that engage in multiple activities, or use several business models at once (Ray *et al.*, 2004; Sund *et al.*, 2016).

In conclusion, we see the approach introduced in this paper both in the context of further research on integration and its consequences and as a practical tool for companies. It can be used to identify firms with a high or low level of resource integration capability. This would make it possible to investigate further these companies and reconstruct how they support dynamic capabilities, as well as commonalities across firms with high and low levels of this capability. The approach can also provide input, especially to top management, as to where resources are weakly or strongly integrated and weak and strong points in regard to how companies integrate with changing environments.

Further work is needed to test the scale and its relevance in different contexts and to track changes over time. There are also a few limitations to this work. First, the response rate of 29 per cent was not very high. It was measured as the number of responses relative to the total number of employees at the time. This means that we may have a somewhat distorted picture of the resource configurations. Second, we have not carried out sub-analyses of different employee categories. This would require larger samples. Such analyses may reveal intra-firm differences in the perceptions of how resources integrate together. Third, the items used were very standard. Items were meant to be applied to the "whole company" in a general way. For some employment categories, this type of decontextualized item could perhaps be difficult to rate. Finally, as a first attempt, it was rather difficult to interpret the cluster structures to the company context. Therefore, it would also be helpful to conduct further qualitative data collection to better understand the underpinning resource integration issues in a case company. Finally, dynamic capabilities are critical to competitive advantage, and it would be useful to investigate the relationship between resource integration and organizations' performance in a future study.

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Appendix

View	Resource combination	Code	Question
Int.	People-Technology	PT1	In our company we use methods which are easy to use
Int.	People-Technology	PT2	Our kind of teamwork improves the skills of employees
Ext.	People-Technology	PTE	Employees develop their knowledge to improve the company's competitiveness
Int.	People-Organization	PO1	Our organization matches the skills of employees to particular jobs
Int.	People-Organization	PO2	Our organization cares about people
Ext.	People-Organization	POE	Our organization engages external stakeholders
Int.	People-Infrastructure	PI1	Our offices fit work requirements
Int.	People-Infrastructure	PI2	Our company's location is practical for me
Ext.	People-Infrastructure	PIE	Visitors enjoy our offices
Int.	People-Economy	PE1	Employees are keen to help the company economize
Int.	People-Economy	PE2	In general employees are thrifty with company money
Int.	People-Economy	PE3	Employees want the company to seize profitable opportunities
Ext.	People-Economy	PEE	Our company is ready to take economic risks in new markets
Int.	Technology-Organization	TO1	IT-systems help employees organize their work
Int.	Technology-Organization	TO2	Our accounts make our organization more transparent
Ext.	Technology-Organization	TOE	Our organization applies scientific methods to be a front-runner
Int.	Technology-Infrastructure	TI1	Company "know-how" is protected against theft
Int.	Technology-Infrastructure	TI2	Our homepage on the web helps different company locations to share external information
Ext.	Technology-Infrastructure	TIE	Offices have the necessary technology tools to sense the market
Int.	Technology-Economy	TE1	We do not overspend on computer technology
Int.	Technology-Economy	TE2	We constantly upgrade our knowledge to be able to make the right investments
Ext.	Technology-Economy	TEE	Our new databases give us a cost advantage
Int.	Organization-Infrastructure	OI1	My office is designed to facilitate my work
Int.	Organization-Infrastructure	OI2	The company operations are located as well as they can
Ext.	Organization-Infrastructure	OIE	Our organization's offices are certified as "environmentally sound"
Int.	Organization-Economy	OE1	Money is allocated so as to be of best use to the organization
Int.	Organization-Economy	OE2	Economic planning is well anchored in the organization
Int.	Organization-Economy	OE3	Given environmental uncertainty, time devoted to business planning is reasonable
Ext.	Organization-Economy	OEE	Salaries in our organization attract external talent
Int.	Infrastructure-Economy	IE1	Our offices contribute to making us more efficient at work
Int.	Infrastructure-Economy	IE2	Facilities in the company are managed economically
Int.	Infrastructure-Economy	IE3	Offices are designed to help employees meet with clients
Ext.	Infrastructure-Economy	IEE	We are seen by external stakeholders as saving money on office costs through our environmentally sound thinking
Int.	Overall	OVI	All resources of our company support each other to a maximum extent
Ext.	Overall	OVX	We constantly develop our competencies to meet changing environments

Table AI.
The IPOET scale

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